What is claimed is:

1. An apparatus for optically inspecting a sample, the apparatus comprising:

an illumination source that generates a probe beam;

a series of optical components that cause a portion of the probe beam to be reflected by a measurement area on the sample surface and subsequently transported to a detector, where the series of optical components includes at least one mirror, meeting the condition $TSE(D) \leq 2e^{-0.15D}$ where $TSE(D) = E_{mirror}(D)/E_{ideal}(D)$ where $E_{mirror}(D)$ is the encircled energy of the mirror measured as a function of the included diameter D and $E_{ideal}(D)$ is the encircled energy for an ideal diffraction-limited mirror of equal focal length and numerical aperture; and

a processor for analyzing signals generated by the detector.

2. An apparatus as recited in claim 1, wherein *TSE(D)* is a monotonically decreasing function of *D*.

3. An apparatus as recited in claim 1, wherein the mirror comprises:

a glass substrate; and

a reflective coating.

4. An apparatus as recited in claim 1, wherein the mirror is formed using a glass master.

5. An apparatus as recited in claim 1, wherein the mirror is formed by:

diamond turning a substrate to a desired shape; and

polishing the substrate to a surface roughness of approximately 10 Angstroms RMS.

6. An apparatus as recited in claim 1, wherein the mirror is formed by:
forming an aluminum substrate to a desired shape; and
super-polishing the substrate to meet the condition $TSE(D) \leq 2e^{-0.15D}$.

7. An apparatus for optically inspecting a sample, the apparatus comprising:
an illumination source that generates a probe beam;
a first series of optical components that direct the probe beam to be reflected by the sample;
a second series of optical components that gather the reflected probe beam from a measurement area on the sample surface, where the series of optical components includes at least one mirror, and where the series of optical components transports at least 99% of the gathered illumination to a detector; and
a processor for analyzing signals generated by the detector.

8. An apparatus as recited in claim 7, wherein the mirror comprises:
a glass substrate; and
a reflective coating.

9. An apparatus as recited in claim 7, wherein the mirror is formed using a glass master.

10. An apparatus as recited in claim 7, wherein the mirror is formed by:
diamond turning a substrate to a desired shape; and
polishing the substrate to meet the condition $TSE(D) \leq 2e^{-0.15D}$ where $TSE(D) = E_{mirror}(D)/E_{ideal}(D)$ where $E_{mirror}(D)$ is the encircled energy of the mirror measured as a function of the included diameter D and $E_{ideal}(D)$ is the encircled energy for an ideal diffraction-limited mirror of equal focal length and numerical aperture.

11. An apparatus as recited in claim 10, wherein *TSE(D)* is a monotonically decreasing function of *D*.

12. An apparatus as recited in claim 7 wherein the mirror is formed by:

forming an aluminum substrate to a desired shape; and

super-polishing the substrate to meet the condition $TSE(D) \leq 2e^{-0.15D}$ where $TSE(D) = E_{mirror}(D)/E_{ideal}(D)$ where $E_{mirror}(D)$ is the encircled energy of the mirror measured as a function of the included diameter *D* and $E_{ideal}(D)$ is the encircled energy for an ideal diffraction-limited mirror of equal focal length and numerical aperture.

13. An apparatus as recited in claim 12, wherein *TSE(D)* is a monotonically decreasing function of *D*.

14. An apparatus as recited in claim 7 in which the measurement area is no larger than 50 microns.

15. An apparatus for optically inspecting a sample, the apparatus comprising:

an illumination source that generates a probe beam;

a series of optical components that cause a portion of the probe beam to be reflected by a measurement area on the sample surface and subsequently transported to a detector, where the series of optical components includes at least one mirror, and where at least 99% of the portion of the probe beam that is reflected by the measurement area reaches the detector; and

a processor for analyzing signals generated by the detector.

16. An apparatus as recited in claim 15, wherein the mirror comprises:

a glass substrate; and

a reflective coating.

17. An apparatus as recited in claim 15, wherein the mirror is formed using a glass master.

18. An apparatus as recited in claim 15, wherein the mirror is formed by:

diamond turning a substrate to a desired shape; and

polishing the substrate to meet the condition $TSE(D) \le 2e^{-0.15D}$ where $TSE(D) = E_{mirror}(D)/E_{ideal}(D)$ where $E_{mirror}(D)$ is the encircled energy of the mirror measured as a function of the included diameter D and $E_{ideal}(D)$ is the encircled energy for an ideal diffraction-limited mirror of equal focal length and numerical aperture.

19. An apparatus as recited in claim 18, wherein *TSE(D)* is a monotonically decreasing function of *D*.

20. An apparatus as recited in claim 15, wherein the mirror is formed by:

forming an aluminum substrate to a desired shape; and

super-polishing the substrate to meet the condition $TSE(D) \le 2e^{-0.15D}$ where $TSE(D) = E_{mirror}(D)/E_{ideal}(D)$ where $E_{mirror}(D)$ is the encircled energy of the mirror measured as a function of the included diameter D and $E_{ideal}(D)$ is the encircled energy for an ideal diffraction-limited mirror of equal focal length and numerical aperture.

21. An apparatus as recited in claim 20, wherein *TSE(D)* is a monotonically decreasing function of *D*.

22. An apparatus as recited in claim 15 in which the measurement area is no larger than 50 microns.

23. A method for optically inspecting a sample, the method comprising:

generating an optical probe beam;

using a series of optical components to cause a portion of the probe beam to be reflected by a measurement area on the sample surface and subsequently transported to a detector, where the series of optical components includes at least one mirror, meeting the condition $TSE(D) \leq 2e^{-0.15D}$ where $TSE(D) = E_{mirror}(D)/E_{ideal}(D)$ where $E_{mirror}(D)$ is the encircled energy of the mirror measured as a function of the included diameter D and $E_{ideal}(D)$ is the encircled energy for an ideal diffraction-limited mirror of equal focal length and numerical aperture; and

analyzing signals generated by the detector.

24. An apparatus as recited in claim 23, wherein *TSE(D)* is a monotonically decreasing function of *D*.

25. A method as recited in claim 23, wherein the mirror comprises:

a glass substrate; and

a reflective coating.

26. A method as recited in claim 23, wherein the mirror is formed using a glass master.

27. A method as recited in claim 23, wherein the mirror is formed by:

diamond turning a substrate to a desired shape; and

polishing the substrate to meet the condition $TSE(D) \leq 2e^{-0.15D}$.

28. A method as recited in claim 23, wherein the mirror is formed by:

forming an aluminum substrate to a desired shape; and

super-polishing the substrate to meet the condition $TSE(D) \leq 2e^{-0.15D}$.

29. A method for optically inspecting a sample, the method comprising:

generating an optical probe beam;

using a first series of optical components to direct the probe beam to be reflected by the sample;

using a second series of optical components to gather the reflected probe beam from a measurement area on the sample surface, where the series of optical components includes at least one mirror, and where the series of optical components transports at least 99% of the gathered illumination to a detector; and

analyzing signals generated by the detector.

30. A method as recited in claim 29, wherein the mirror comprises:

a glass substrate; and

a reflective coating.

31. A method as recited in claim 29, wherein the mirror is formed using a glass master.

32. A method as recited in claim 29, wherein the mirror is formed by:

diamond turning a substrate to a desired shape; and

polishing the substrate to a surface roughness meeting conditions meet the condition $TSE(D) \leq 2e^{-0.15D}$ where $TSE(D) = E_{mirror}(D)/E_{ideal}(D)$ where $E_{mirror}(D)$ is the encircled energy of the mirror measured as a function of the included diameter D and $E_{ideal}(D)$ is the encircled energy for an ideal diffraction-limited mirror of equal focal length and numerical aperture.

33. An apparatus as recited in claim 32, wherein *TSE(D)* is a monotonically decreasing function of *D*.

34. A method as recited in claim 23, wherein the mirror is formed by:

forming an aluminum substrate to a desired shape; and

super-polishing the substrate to meet the condition $TSE(D) \leq 2e^{-0.15D}$ where $TSE(D) = E_{mirror}(D)/E_{ideal}(D)$ where $E_{mirror}(D)$ is the encircled energy of the mirror measured as a function of the included diameter D and $E_{ideal}(D)$ is the encircled energy for an ideal diffraction-limited mirror of equal focal length and numerical aperture.

35. An apparatus as recited in claim 34, wherein *TSE(D)* is a monotonically decreasing function of *D*.

36. A method as recited in claim 32 in which the measurement area is no larger than 50 microns.

37. A method for optically inspecting a sample, the method comprising:

generating an optical probe beam;

using a series of optical components to cause a portion of the probe beam to be reflected by a measurement area on the sample surface and subsequently transported to a detector, where the series of optical components includes at least one mirror, and where at least 99% of the portion of the probe beam that is reflected by the measurement area reaches the detector; and

analyzing signals generated by the detector.

38. A method as recited in claim 37, wherein the mirror comprises:

a glass substrate; and

a reflective coating.

39. A method as recited in claim 37, wherein the mirror is formed using a glass master.

40. A method as recited in claim 37, wherein the mirror is formed by:

diamond turning a substrate to a desired shape; and

polishing the substrate to meet the condition $TSE(D) \leq 2e^{-0.15D}$ where $TSE(D) = E_{mirror}(D)/E_{ideal}(D)$ where $E_{mirror}(D)$ is the encircled energy of the mirror measured as a function of the included diameter D and $E_{ideal}(D)$ is the encircled energy for an ideal diffraction-limited mirror of equal focal length and numerical aperture.

41. An apparatus as recited in claim 40, wherein *TSE(D)* is a monotonically decreasing function of *D*.

42. A method as recited in claim 37, wherein the mirror is formed by:

forming an aluminum substrate to a desired shape; and

super-polishing the substrate to meet the condition $TSE(D) \leq 2e^{-0.15D}$ where $TSE(D) = E_{mirror}(D)/E_{ideal}(D)$ where $E_{mirror}(D)$ is the encircled energy of the mirror measured as a function of the included diameter D and $E_{ideal}(D)$ is the encircled energy for an ideal diffraction-limited mirror of equal focal length and numerical aperture.

43. An apparatus as recited in claim 42, wherein *TSE(D)* is a monotonically decreasing function of *D*.

44. A method as recited in claim 37 in which the measurement area is no larger than 50 microns.

45. A method for fabricating low-noise optical components for use in optical metrology systems, the method comprising:

creating a substrate that is similar in shape to the component to be produced;

positioning a deformable layer over the substrate; and

press forming the deformable layer using a master made from optical glass.

46. A method as recited in claim 45 in which the component is a mirror meeting the condition $TSE(D) \leq 2e^{-0.15D}$ where $TSE(D) = E_{mirror}(D)/E_{ideal}(D)$ where $E_{mirror}(D)$ is the encircled energy of the mirror measured as a function of the included diameter D and $E_{ideal}(D)$ is the encircled energy for an ideal diffraction-limited mirror of equal focal length and numerical aperture.

47. A method as recited in claim 46 in which *TSE(D)* is a monotonically decreasing function of *D*.